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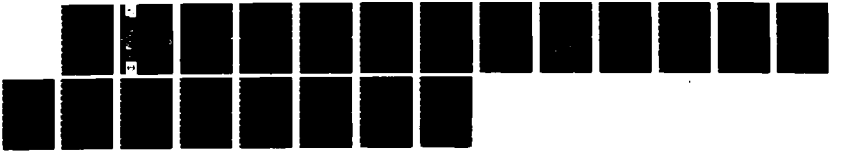

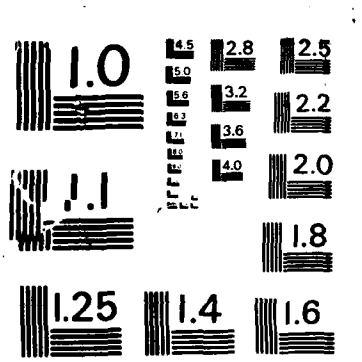

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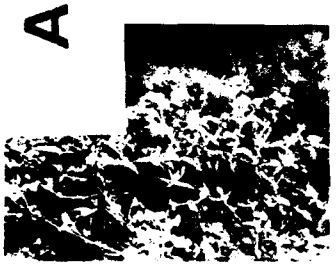

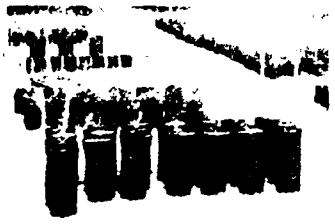

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TECHNICAL REPORT EL-86-28

TALL WHEATGRASS (*Agropyron elongatum*)

Section 7.1.3, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

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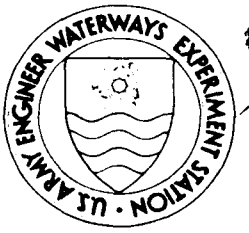

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

A plant materials report on tall wheatgrass (*Agropyron elongatum*) is provided as Section 7.1.3 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist the Corps District or project biologist with the selection, cultivation, and management of suitable plant materials for wildlife and habitat management programs. Topics covered include description, distribution, habitat requirements, establishment, maintenance, and cautions and limitations.

Tall wheatgrass is an introduced perennial, cool-season bunchgrass that grows well in saline-sodic soils and subirrigated sites, especially in the West. The species is planted for pasture, hay, wildlife cover, soil protection, and site reclamation. Diagnostic features of tall wheatgrass are described, and the species distribution and region of greatest management use are given. Habitat requirements are discussed, and soil and moisture tolerances are specified. Information on food and cover value for wildlife is presented. Guidelines are
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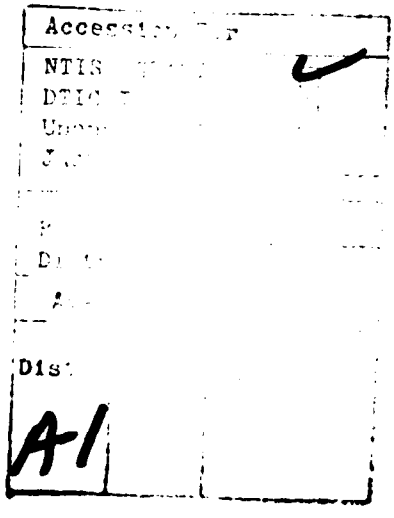
provided for establishing tall wheatgrass stands on range sites, along rights-of-way, and on erosive and disturbed sites; topics include site selection, site preparation, propagule selection, and planting mixtures. Seed mixtures for restoring big game range are given. Maintenance requirements and appropriate cautions and limitations are noted.



PREFACE

This work was sponsored by the Office, Chief of Engineers (OCE), US Army, as part of the Environmental Impact Research Program (EIRP), Work Unit 31631, entitled Management of Corps Lands for Wildlife Resource Improvement. The Technical Monitors for the study were Dr. John Bushman and Mr. Earl Eiker, OCE, and Mr. Dave Mathis, Water Resources Support Center.

This report was prepared by Mr. Clinton H. Wasser, Professor Emeritus, Range Science Department, Colorado State University, Fort Collins, Colo.; Dr. Phillip L. Dittberner, US Fish and Wildlife Service, Western Energy and Land Use Team (WELUT), Fort Collins, Colo.; and Dr. Donald R. Dietz, US Fish and Wildlife Service, Habitat Resources, Grand Junction, Colo., under an Interagency Agreement with the US Army Engineer Waterways Experiment Station (WES). Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), WES, was principal investigator for the work unit. Ms. Cathy Short and Ms. Pam Hutton, WELUT, assisted with manuscript preparation, and Ms. Jennifer Shoemaker, WELUT, prepared the original drawings. Review and comments were provided by Mr. Martin and Dr. Wilma A. Mitchell, WTHG, and Mr. Larry E. Marcy, Texas A&M University.

The report was prepared under the general supervision of Dr. Hanley K. Smith, Chief, WTHG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. Dr. Roger T. Saucier, WES, was Program Manager, EIRP. The report was edited by Ms. Jessica S. Ruff of the WES Publications and Graphic Arts Division.

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NOTE TO READER

This report is designated as Section 7.1.3 in Chapter 7 -- PLANT MATERIALS, Part 7.1 -- GRASSES, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 7.

TALL WHEATGRASS *(Agropyron elongatum)*

Section 7.1.3, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

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Tall wheatgrass is an introduced perennial, cool-season bunchgrass that grows well in saline-sodic soils and subirrigated sites, especially in the West. The species is planted for pasture, hay, wildlife cover, soil protection, and reclamation of saline-alkali soils (Hafenrichter et al. 1968, Plummer et al. 1968, Thornburg 1982).

DESCRIPTION

Tall wheatgrass is a vigorous, robust species that grows in large tufts up to 2 ft (6 dm) in diameter. The stiffly erect culms are 2 to 6 ft (0.6 to 1.8 m) tall. Leaf blades are medium in width, green or blue-green, flat to loosely inrolled, strongly nerved, and 6 to 14 in. (15 to 36 cm) long, with erect, nonclasping auricles (Fig. 1). Plants have coarsely fibrous roots that often extend into relatively shallow water tables (Plummer et al. 1955, Robertson 1955).

The seedheads are erect, spikelike, and 6 to 12 in. (15 to 30 cm) long. The spikelets are approximately 1 in. (2.5 cm) long, 6- to 12-flowered, and appressed to the rachis when immature but diverse from the rachis in an arc when nearing maturity and drying; there is one spikelet per rachis node. Unlike in other wheatgrasses, the glumes are distinctive with truncate (square) tips. The seeds are similar to small grains of wheat (Cronquist

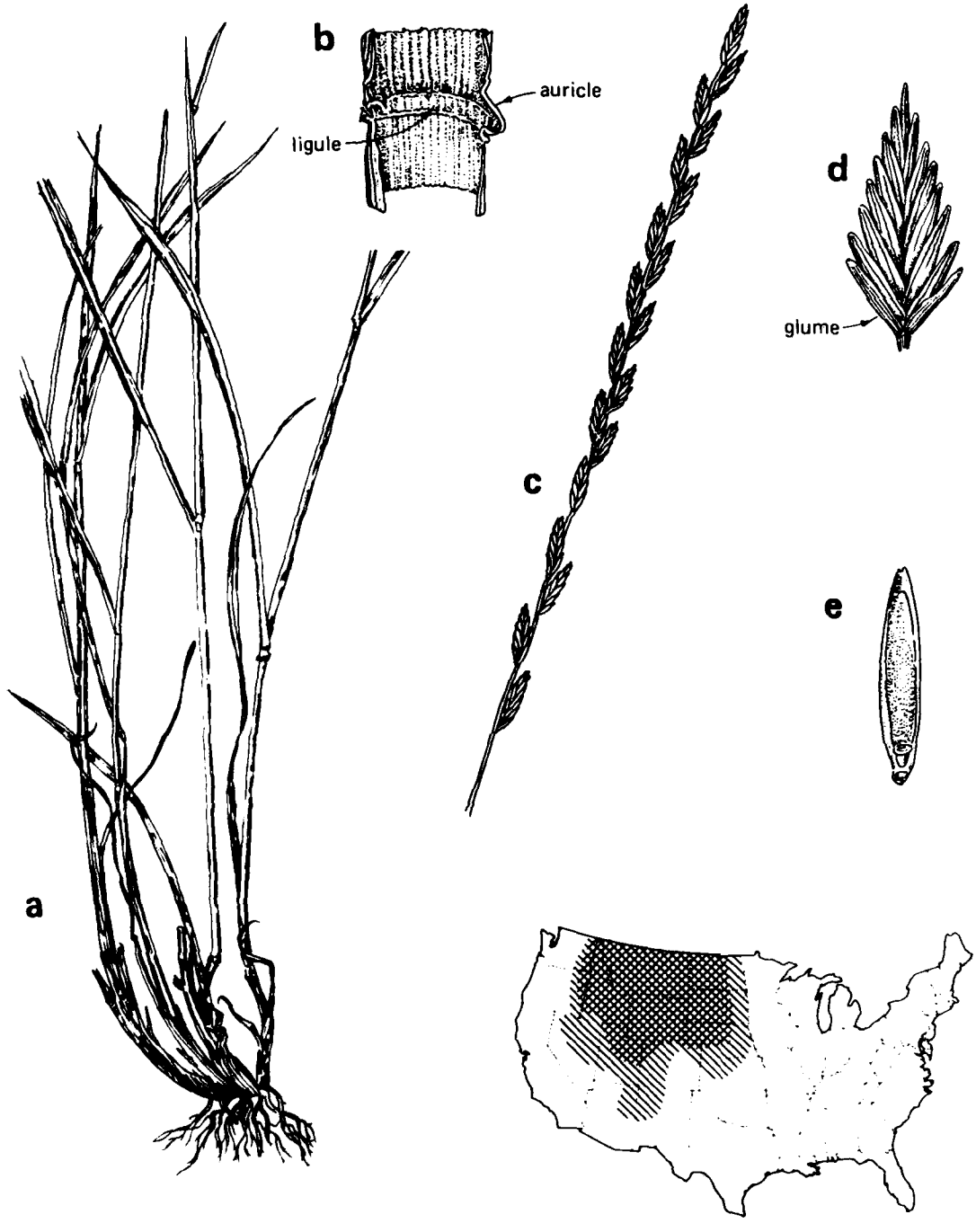

Figure 1. Distribution and distinguishing characteristics of tall wheatgrass (*Agropyron elongatum*): (a) culms, (b) ligule and auricle, (c) seedhead, (d) spikelet, and (e) floret showing seed (after Hafenrichter et al. 1968). The map shows the overall species distribution (diagonal lines) and region of greatest management use (crosshatching) (after Atkins and Smith 1967)

et al. 1977, Wasser 1982). Growth begins in midspring, usually in April, and continues all summer if soil moisture is adequate. Plants mature in August or September over most of the species range (Wasser 1982).

DISTRIBUTION

Tall wheatgrass is native to Turkey, Asia Minor, and Russia, where it grows in saline meadows and along seashores. In the United States, the species is common throughout the Northern Great Plains, Great Basin region, and Western States but does not occur in California. Major distribution is from the central Dakotas and western Nebraska northwest to Idaho and Montana (Atkins and Smith 1967).

HABITAT REQUIREMENTS

Vegetation types often associated with tall wheatgrass include sagebrush steppe, grama-needlegrass-wheatgrass, wheatgrass-needlegrass, and wheatgrass-bluestem-needlegrass. Common plant associates in these vegetation types include western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*A. spicatum*), big bluestem (*Andropogon gerardii*), blue grama (*Bouteloua gracilis*), big sagebrush (*Artemisia tridentata*), sandreed (*Calamovilfa longifolia*), needle-and-thread grass (*Stipa comata*), needlegrass (*S. spartea*), and green needlegrass (*S. viridula*) (Kuchler 1964).

Tall wheatgrass grows well on suitable sites between 500 and 7500 ft in elevation, but abundance depends on latitude and exposure. Weintraub (undated) reported that the species did not survive above 7600 ft in south-central Colorado during the cold, dry winter of 1949-1950. Tall wheatgrass grows best in full sunlight, and its shade tolerance is only fair (Shaw and Cooper 1973).

Soils

Tall wheatgrass thrives on medium- to fine-textured sandy to clayey soils (Shaw and Cooper 1973, Thornburg 1982). It has the highest tolerance of any commonly cultivated grass to saline, saline-sodic, and nonsaline-sodic soils. In one study, production declined only 10% at soil salinity levels of EC = 10 µmhos/cm (Bernstein 1964). Tall wheatgrass has also been established on alkaline soils with a pH of 10.1 (SCS 1972). The species has moderate fertilizer requirements, and dense stands become less productive without

nitrogen fertilizers or the presence of perennial legumes (Shaw and Cooper 1973, Wasser 1982).

Moisture

Tall wheatgrass thrives in the 16- to 24-in. mean annual precipitation (MAP) zone. However, growth is satisfactory with a minimum of 14 in. MAP, and the species is recommended for planting in salty, water-accumulating sites in the 5- to 9-in. zones (Hafenrichter et al. 1968, Lang et al. 1975, Thornburg 1982). Mature plants can withstand 5 to 7 weeks of early spring flooding and shallow water tables if the top 6 in. of soil is unsaturated. The species has been reported as weakly to moderately drought resistant (Shaw and Cooper 1973), but Weintraub (undated) stated that plants were drought tolerant.

WILDLIFE VALUE

Stands of tall wheatgrass provide food and cover for a variety of wildlife species (Hafenrichter et al. 1968, SCS 1972, Thornburg 1982). Tall wheatgrass is a preferred species for reestablishing dense wildlife cover on saline and alkaline sites because of the tall thickets produced, ease of establishment, and tolerance to harsh soil conditions. It is not recommended as a wildlife planting at sites above 7000 ft in elevation.

Tall wheatgrass is frequently used as a 2- to 4-row windbreak in the central and northern Great Plains. It is used for wildlife habitat development in the Pacific Northwest and Great Basin States where the tall, persistent, bunchy growth provides nesting cover for upland game birds; for these plantings, interrupted drill strips alternated with lower growing species provide excellent cover and good hunting (Hafenrichter et al. 1968). Tall wheatgrass is also used to establish wildlife cover, nesting sites, and travel lanes through plowed fields (Olson 1977, Johnson and Anderson 1980).

In combination with alfalfa (*Medicago sativa*), tall wheatgrass is recommended for seeding along roadsides in northeastern Colorado to establish ring-necked pheasant (*Phasianus colchicus*) nesting cover (Hoffman 1973, Snyder 1974). In western Colorado, tall wheatgrass provides good nesting and escape cover for pheasants because of its affinity for saline meadows and areas along irrigation ditches (Bob Elderkin, U.S. Bureau of Land Management, Grand Junction, Colo., pers. commun., October 1984).

The forage value of tall wheatgrass is low for deer (*Odocoileus* spp.) and pronghorn (*Antilocapra americana*) and moderate for cattle, sheep, horses, elk (*Cervus elaphus*), upland game birds, songbirds, and small mammals (Dennis and Antonio 1980). Shaw and Cooper (1973) rated tall wheatgrass as fair spring and fall forage for elk in Montana. This species may be especially useful in revegetating oil shale mine spoils on mule deer (*O. hemionus*) range because of its tolerance to highly sodic soils associated with processed oil shales; tall wheatgrass and several other wheatgrasses were the only seeded species to show consistent emergence in revegetation trials on oil shale mine spoils in the Piceance Basin of Colorado (Redente et al. 1981). The species was also found to be highly productive when used in seeding trials on Kaibab mule deer winter range in Arizona (Russo 1964).

ESTABLISHMENT

Site Selection

Big game winter and/or spring-fall concentration areas that lack adequate cover and forage should be evaluated for seeding to tall wheatgrass. Other potential sites include depleted and disturbed rangelands and sites that have saline subirrigated and imperfectly drained sodic sites within their boundaries. Mixtures of tall wheatgrass with perennial legumes or complex grass-forb-shrub mixtures may be more feasible when saline-sodic sites are interspersed among a more uniform and extensive project area.

Sites selected for seeding should have grades of less than 15% because bunchgrasses are not very effective in controlling erosion on steeper slopes. Tall wheatgrass, alone or in a mixture, is a suitable choice for roadsides and other rights-of-way in the northern Great Plains and Intermountain regions where nesting cover for pheasants is deficient or marginal (Cook et al. 1970, Snyder 1974). In the western portions of the central and northern Great Plains, windy areas with inadequate cover often benefit from seeding tall wheatgrass in 2- or 4-row plantings as field wind barriers or windbreaks (Johnson and Anderson 1980). Erosive shorelines along reservoirs, lakes, and coastal areas can be stabilized by planting tall wheatgrass (Shaw and Cooper 1973). Richardson et al. (1975) reported the successful use of tall wheatgrass in various mixtures for reclaiming mine spoils and other disturbed lands in the coal-mining areas of Montana.

Site Preparation

Plot design. Plots should usually not exceed 80 to 120 acres nor be more than 600 to 1200 ft across in brush or woodland areas. Elongated fields are preferred, and plots should have irregular margins where possible. Better wildlife population response and hunting opportunities have been reported where tall wheatgrass row plantings were interspersed with shorter vegetation (Hafenrichter et al. 1968).

Designs for field barriers and windbreaks using tall wheatgrass are somewhat variable. Johnson and Anderson (1980) recommended 2-row strips planted at the windward edge of fields; strips planted at right angles to prevailing winds and at regular intervals across fields served as windbreaks to drift snow. Windier areas and more erosive soils may require 4 rows instead of 2, particularly in drier climates where grasses do not grow as tall. Two-row grass strips are usually effective for a distance of only about 70 ft.

Mechanical treatment. Vegetative competition needs to be reduced to a minimum to encourage better seedling establishment. Scalpers, one-way disk-plows, cutaway disks, and brushland plows are effective in reducing saltgrass (*Distichlis stricta*), greasewood (*Sarcobatus* spp.), and rabbitbrush (*Chrysothamnus* spp.) on most sites adapted to tall wheatgrass. Additional disking and/or harrowing may be needed to prepare a firm seedbed suitable for drilling. Soils usually settle and become firm enough to establish a good seedbed if several weeks are allowed between site disturbance and seeding.

Roadsides should be double-disked or rototilled before seeding to eliminate competition. Perennial weeds may need to be sprayed with a herbicide; herbicide manuals should be consulted for recommended and approved herbicides and dosages. Field barrier and windbreak plantings can be made on firm, weed-free seedbeds prepared at the same time that grain or intertilled crop fields are prepared for planting.

Soil amendments. Tall wheatgrass responds to nitrogen fertilizers on irrigated and subirrigated lands and where grown in rows for seed production under dryland conditions. Nitrogen can be added as a surface dressing in fall or spring. In the Pacific Northwest, 60 to 80 lb of nitrogen per acre, applied annually, is the recommended rate for fertilizing wide row spacings to increase seed production (Hafenrichter et al. 1968). The application of fertilizer does not appear to be cost effective in strictly dryland environments unless the topsoil has been removed or mixed with subsoil material.

Irrigation. Tall wheatgrass responds well to irrigation and can be used for irrigated pasture and as a hay crop. Irrigation before seeding is recommended to leach the salts below the root depth of developing seedlings. Soils should be tested for the kind and amount of salts present because saline soil conditions can be made worse by irrigation (Hafenrichter et al. 1968). Frequent light irrigation during the first growing season is suggested. Thereafter, the frequency of irrigation will depend on the amount of water available through subirrigation and precipitation. Some sites may require no more than 3 irrigations, while others may need irrigation every 2 or 3 weeks throughout the summer to maintain vigorous growth.

Propagule Selection

Tall wheatgrass is most often established from seed, which is usually commercially available in adequate quantities. Only small-scale, critically erosive sites justify establishing stands by transplanting container-grown seedlings or whole plants.

Cultivars. There are 5 recognized cultivars of tall wheatgrass. Alkar, a late-maturing, highly productive variety with a vigorous root system, is widely used in the Intermountain and northern Great Plains regions. Jose is a less coarse, earlier maturing cultivar released from New Mexico. Largo is used widely in Colorado, Utah, Arizona, New Mexico, and California. Orbit is a Canadian release, selected for improved winter hardiness. Platte was developed from two Nebraska and Wyoming strains. Plant material specialists should be consulted for help in selecting the best variety for particular seeding sites and purposes.

Seed selection. Seeds can be harvested by cutting grass in immature stages with a binder or by windrowing and then combining. Plants can also be directly combined when seeds are mature. A fairly high percentage of seed shatters and falls on the ground when combined at maturity. Fanning mills can be used to clean seeds to commercial quality (Atkins and Smith 1967).

Seed quality is usually 90% to 95% purity, 85% to 90% germination, and 77% to 81% pure live seed (PLS). Tall wheatgrass usually has 75,000 to 80,000 seeds per pound (Association of Official Seed Analysts 1978, Fulbright et al. 1982, Wasser 1982). Germination occurs in approximately 21 days under ideal conditions. Prechilling or stratification hastens germination (Association of Official Seed Analysts 1978, Fulbright et al. 1982, Wasser 1982). Seedling vigor is generally good to very good, and stands are established by the second

or third growing season after planting. Nonirrigated sites require slightly longer for establishment than do irrigated sites (Thornburg 1982, Wasser 1982).

Planting Methods

Time of seeding. Seeds can be planted in late summer (August 15-September 15) in areas of dependable early fall moisture (e.g., below the 4000-ft elevation in the inland Pacific Northwest). Seedings are made in late fall at higher elevations of the Intermountain region and in early spring in the central and northern Great Plains (Dahl et al. 1967, Plummer et al. 1968).

Seeding. Seed can be planted by ordinary grain, grass, Oregon press, double-disk, deep-furrow, and rangeland drills. Planting with a deep-furrow drill is advantageous in moist, flooded, and irrigated saline sites because the seed is planted in furrows while the salts are concentrated on the ridges by evaporation (Hafenrichter et al. 1968). The rangeland drill is most commonly used for seeding rougher and rockier rangelands. Seeds can also be broadcast by cyclone-type hand seeders, motorized seeders attached to tractors, or by fixed-wing airplanes or helicopters equipped with positive power-driven, seed-metering devices. Broadcasting is usually less satisfactory than drilling and should be reserved for more remote, rougher, and perhaps steeper slopes that are less amenable to seeding with tractors and drills (Plummer et al. 1955, 1968; Merkel and Currier 1973).

Alternating row plantings of tall wheatgrass with shorter vegetation is recommended (Hafenrichter et al. 1968). The shorter vegetation can consist of existing grasses and forbs, or tall wheatgrass may be seeded with shorter species such as western wheatgrass. Alfalfa or sweetclover (*Melilotus* spp.) can be seeded through a small legume seedbox when planted in alternating rows with tall wheatgrass.

Drilled or broadcast seeds should be covered 1/4 in. deep in fine soils and up to 1-1/2 in. deep in coarser soils. Seeding rates vary with site conditions, purposes, and methods. Common rates for seeding drylands are 8 to 12 lb/acre, whereas rates for irrigated monocultures range from 10 to 20 lb/acre. Rates for broadcasting are usually 50% to 100% greater than rates for drilling, while critically erosive sites may require still greater rates. Merkel and Herbel (1973) recommended 40 to 50 PLS/square foot for seeding critical areas when drilled and 60 PLS/square foot when broadcast.

Drill row spacings of 12 to 21 in. for dryland seedings and 12 in. for irrigated areas are suggested because of the large size of tall wheatgrass plants and the early stagnation of dense stands (Hull et al. 1952; Plummer et al. 1955, 1968; Stewart 1970; SCS 1972; Wasser 1982). Row spacings for wind barrier and windbreak field plantings are usually 3 to 5 ft between the wheatgrass rows to encourage greater height and forage production (Johnson and Anderson 1980).

Transplanting. Although transplanting tall wheatgrass is not generally considered cost effective, seedlings can be grown in pots in greenhouses and transplanted to furrows or holes after reaching the 4-leaf stage. Decomposable containers are preferred, as grasses do not survive well when planted as bare-rooted stock. Young plants or divisions of mature plants can be transplanted by digging them up when the soil is moist, placing the plants in paper or coarsely woven fiber bags, and keeping them moist and shaded until planted. Transplanting is preferably done at the start of the spring or fall growing season. Seedlings need to be irrigated weekly during the first growing season when soil moisture is unavailable.

Planting Mixtures

Tall wheatgrass is usually planted as a single species for pasture development and in irrigated areas that are used primarily for grazing. However, seed mixtures with other grasses, forbs, and shrubs can decrease grazing pressure and provide better forage and cover conditions for wildlife. Seed mixtures used for restoring big game ranges in Utah and the Intermountain region are listed in Tables 1 and 2.

MAINTENANCE

Tall wheatgrass is tolerant of fire, which can be used to control non-sprouting shrubs and other weedy invaders in wheatgrass stands (Wright and Bailey 1982). Weeds are usually not a serious problem in drilled row plantings, but herbicides may be needed to control abundant broad-leaved weeds in pure stands. If alfalfa is sown in the mixture, options to control weeds include cultivating between the rows with narrow shovels or mowing weeds in the stem elongation stage. Narrow shovels are recommended over lister or duckfoot tillage tools to avoid smothering seedlings. When mowing weeds, the blades should be set to mow above the grass seedlings. Mowing the stand at a 12- to 15-in. height before grazing is allowed may be advantageous because the

Table 1. Species commonly planted with tall wheatgrass in Utah (Plummer et al. 1968)

Species	Rangeland Types: Black greasewood (*Sarcobatus vermiculatus*)	Rangeland Types: Inland saltgrass (*Distichlis stricta*)
Grasses		
Crested wheatgrass (*Agropyron cristatum*)	X	X
Intermediate wheatgrass (*A. intermedium*)	X	X
Quackgrass* (*A. pungens*)	X	
Pubescent wheatgrass (*A. trichophorum*)	X	
Tall wheatgrass (*A. elongatum*)	X	X
Basin wildrye (*Elymus cinereus*)		X
Russian wildrye (*E. junceus*)	X	X
Tall fescue (*Festuca arundinacea*)	X	X
Forbs		
Pacific aster (*Aster chilensis ascendens*)		X
Yellow sweetclover (*Melilotus officinalis*)	X	X
Strawberry clover (*Trifolium fragiferum*)	X	X
Shrubs		
Fourwing saltbush (*Atriplex canescens*)	X	X
Gardner saltbush (*A. gardneri*)	X	X
Winterfat (*Ceratoides lanata*)	X	
Rubber rabbitbrush (*Chrysothamnus nauseosus*)	X	

* Not recommended near agricultural areas.

coarse, older, upright stems often discourage close grazing by herbivores. Stagnated stands of tall wheatgrass may need annual application of nitrogen and possibly other nutrients. Nitrogen fertilization is the primary method of renovating old stands of unthrifty wheatgrass (Vallentine 1971, Wasser 1982).

CAUTIONS AND LIMITATIONS

Grazing should not be allowed until after plants produce seed heads. This usually occurs by the end of the first growing season under irrigation and by the end of the second season without irrigation. A 6- to 8-in. stubble

Table 2. Species used in mixtures with tall wheatgrass in the Intermountain region (Plummer et al. 1968)

Grasses
Slender wheatgrass (*Agropyron trachycaulum*)
Western wheatgrass (*A. smithii*)
Meadow foxtail (*Alopecurus angustifolia*)
Canada wildrye (*Elymus canadensis*)
Beardless wildrye (*E. triticoides*)
Salina wildrye (*E. salina*)
Reed canarygrass (*Phalaris arundinacea*)
Nuttall's alkaligrass (*Puccinellia airoides*)
Bottlebrush squirreltail (*Sitanion hystrix*)
Alkali sacaton (*Sporobolus airoides*)
Forbs
Fivehook bassia (*Bassia hyssopifolia*)
Fireweed summercypress (*Kochia scoparia*)
Lewis flax (*Linum lewisii*)
Yellow-flowered alfalfa (*Medicago falcata*)
Black medick (*M. lupulina*)
Common alfalfa (*M. sativa*)
Shrubs
Big sagebrush (*Artemisia tridentata*)
Lanceleaf rabbitbrush (*Chrysothamnus viscidiflorus lanceolatus*)
Russian olive (*Elaeagnus angustifolia*)
Tatarian honeysuckle (*Lonicera tatarica*)
American plum (*Prunus americana*)
Purpleosier willow (*Salix purpurea purpurea*)
Black greasewood (*Sarcobatus vermiculatus*)
Russet buffaloberry (*Shepherdia canadensis*)
Silver buffaloberry (*S. argentea*)

of wheatgrass needs to be maintained during mowing or grazing to avoid lowering the vigor and productivity of seeded stands.

Roadside plantings of tall wheatgrass should not be mowed until after pheasants and other small game have hatched and left their nests. Field barrier and windbreak plantings are more effective if mowed to a 36-in. stubble (Hoffman 1973, Snyder 1974, Johnson and Anderson 1980).

Serious diseases have not been reported in tall wheatgrass. However, the forage quality of plants is sometimes lowered by leaf and stem rusts, particularly in damper climates and moister years. Powdery mildew may infest plants seasonally when prolonged damp weather occurs (Wasser 1982).

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